APPENDIX B

Supporting Information

B-1. Summary of Site Visits to Quantico Creek

Three visits were made to areas of Quantico Creek for the purpose of documenting the site setting of the creek adjacent to the Quantico Marine Corps Base and surrounding areas. Visits were made on 19 July 2001 and 13 June 2002 via car to examine the shoreline around Quantico Creek, and on 9 October 2001 via boat as part of the Quantico Watershed Pilot Study. The site visits focused on the portion of Quantico Creek downstream from the town of Dumfries, VA (the tidally influenced portion of the creek). An Ecological Assessment Checklist (Appendix A from EPA Ecological Risk Assessment Guidance) was completed to provide a composite of site observations regarding site conditions during the three site visits. The major features of Quantico Creek are illustrated in Figure 2-2 of the report. Figures B-1 through B-4 are annotated photos documenting site conditions.

The northeastern boundary of Quantico Marine Corps Base lies at the junction of Quantico Creek and the Potomac River and extends approximately 2.8 kilometers up the south shore of Quantico Creek. The majority of Quantico Creek is shallow, ranging in depth from 1 to 2 meters. Little Creek flows across the Marine Corps Base and empties into Quantico Creek approximately 500 meters upstream of the junction of Quantico Creek with the Potomac River. Most Base activities that could have impacted Quantico Creek occurred in this 500-meter stretch of the creek. The area where Little Creek joins Quantico Creek is a shallow (< 1 meter) delta-like area made up of sands, silts, and abundant organic detritus. During the boat visit, an empty 55-gallon drum was noted in this area, but upon further inspection it appeared to be a float from an upstream pier that had washed into this area. Live clams were also retrieved from this area during the Pilot Study sampling efforts in October 2001. Immediately to the east (downstream) of Little Creek, a railroad bridge crosses Quantico Creek. Passenger and freight trains frequently use this bridge. Just to the east of the railroad bridge is a boat launch and wooden fishing pier. The area surrounding this pier contains several historical outfalls that drained buildings and parking lots around the Marine Corps Base hospital, which is no longer in use. Sections of metal pipe that may be the remnants of outfalls, were noted along the shoreline. The shoreline embankment in this area is generally less than 1 meter in height and lined with rocks in some areas, and heavily vegetated in others. Ring-billed gulls and great blue herons were seen foraging in the lower portion of Quantico Creek during site visits. Immediately across Quantico Creek from the fishing pier and boat launch is the Possum Point Power Plant operated by Dominion Virginia Power. No outfalls or intake pipes from this power plant are evident on Quantico Creek, although an above ground oil pipeline runs along Quantico Creek to the power plant. The area from Little Creek to the Potomac River contains some submerged aquatic vegetation (*Hydrilla*) and some emergent aquatic vegetation in the shallows around the mouth of Little Creek, but vegetation is not as dense as in upstream areas closer to the town of Dumfries. From the mouth of Little Creek upstream to the Marine Corps Base boundary on Quantico Creek, the area is primarily rural and recreational (golf course), with some Base residential areas. No outfalls occur in this area, and any impacts to Quantico Creek would be from non-point-source runoff from the residential areas and the Base golf course. The embankment in this area of the creek ranges from 1 – 2 meters in height and is heavily vegetated. Moderate amounts of *Hydrilla* occur in the nearshore areas of this portion of the south shoreline of Quantico Creek.

Upstream from the base boundary to the town of Dumfries, the shoreline of Quantico Creek is primarily residential, becoming more urban and light industrial within the town limits. The non-tidal portion of Quantico Creek joins the broad, tidally influenced section of the creek in the light industrial area of the town of Dumfries. Quantico Creek at this juncture is a broad, heavily vegetated flood plain opening up into a broad marshy area. Vegetation in the flood plain consists of trees and shrubs, with abundant emergent aquatic vegetation in the marshy area (Figure B-1). Industries located in this area include a boat yard, a cement plant, and a stone/monument works, truck park and numerous warehouses. During the June 2002 site visit, a muskrat was observed swimming in a diversion pond used by the cement plant. The National Oceanic and Atmospheric Administration (NOAA) navigational charts for Quantico Creek

show two areas labeled "Sewage Disposal", one in the residential area on the south shore, and one adjacent to the industrial area. Neither of these "Sewage Disposal" areas were found during the site visits.

The north shore of Quantico Creek from Dumfries to the Possum Point Power Plant is residential. Many of the single-family dwellings abutting the creek were noted to have piers/boat docks extending into the creek. Significant amounts of green algae were noted in the creek adjacent to these residential areas (Figure B-2). The embankment along the entire north shore of Quantico Creek is 2 – 3 meters in height and well vegetated, except where it has been landscaped and contoured to be part of residential yards. Two significant drainage features that contribute water to Quantico Creek were noted along the north shore. One appears to be a permanent stream that flows into Quantico Creek through a culvert under Possum Point Road (Figure B-3). The other is a large drainage swale that does not appear to be a source of permanent water but likely contributes runoff during storm events (Figure B-4).

Figure B-1. Emergent Vegetation on Quantico Creek.

Figure B-2. Algal Growth in Quantico Creek.

Figure B-3. Tributary to Quantico Creek (North Shore)

Figure B-4. Drainage Swale To Quantico Creek (North Shore).

B-2. TRVs Used In Quantico Creek Food-Chain Modeling

Mammalian and avian TRVs used in the ecological food chain modeling are presented in Table B-2. The low TRVs presented in the table are NOAEL-based TRVs, and were used to calculate the HQ1 values presented in the screening-level ecological risk assessment. High TRVs are LOAEL-based TRVs, and were used to calculate HQ2 values to help bound the potential risk condition associated with a given chemical. TRVs developed by Oak Ridge National Laboratory (Sample *et al*., 1997) were used preferentially over other sources. Other literature sources were used only when TRVs were not identified by Sample *et al.* (1997).

Table B-1. Proposed TRVs for Use in Food Chain Modeling in the Quantico Post IRA Study

Analyte	Low Mammalian TRV (mg/kg·d)	Low Mammalian TRV Source	High Mammalian TRV (mg/kg·d)	High Mammalian TRV Source	Low Avian TRV (mg/kg·d)	Low Avian TRV Source	High Avian TRV (mg/kg·d)	High Avian TRV Source
Aluminum	1.93 (2)	Sample et al., 1996	19.3	Sample et al., 1996	109.7	Sample et al., 1996	1097 (1)	Sample et al., 1996
Arsenic	0.126	Sample et al., 1996	1.26 (1)	Sample et al., 1996	2.46	Sample et al., 1996	7.38	Sample et al., 1996
Barium	5.1	Sample et al., 1996	19.8	Sample et al., 1996	20.8	Sample et al., 1996	41.7	Sample et al., 1996
Beryllium	0.66	Sample et al., 1996	6.6 (1)	Sample et al., 1996	n/a		n/a	
Cadmium	1	Sample et al., 1996	10	Sample et al., 1996	1.45	Sample et al., 1996	20.03	Sample et al., 1996
Chromium (+6)	3.3	Sample et al., 1996	13.14	Sample et al., 1996	1	Sample et al., 1996	5	Sample et al., 1996
Cobalt	1.2	Sample et al., 1996	12 (1)	Sample et al., 1996	0.02	PRC, 1996	n/a	
Copper	11.7	Sample et al., 1996	15.1	Sample et al., 1996	47	Sample et al., 1996	61.7	Sample et al., 1996
Lead	8	Sample et al., 1996	80 (1)	Sample et al., 1996	1.13	Sample et al., 1996	11.3 (1)	Sample et al., 1996
Manganese	88	Sample et al., 1996	284	Sample et al., 1996	997	Sample et al., 1996	9970 (1)	Sample et al., 1996
Mercury	0.032	Sample et al., 1996	0.16	Sample et al., 1996	0.0064	Sample et al., 1996	0.064	Sample et al., 1996
Nickel	40	Sample et al., 1996	80	Sample et al., 1996	77.4	Sample et al., 1996	107	Sample et al., 1996
Selenium	0.2	Sample et al., 1996	0.33	Sample et al., 1996	0.5	Sample et al., 1996	1	Sample et al., 1996

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Analyte	Low Mammalian TRV (mg/kg·d)	Low Mammalian TRV Source	High Mammalian TRV (mg/kg·d)	High Mammalian TRV Source	Low Avian TRV (mg/kg·d)	Low Avian TRV Source	High Avian TRV (mg/kg·d)	High Avian TRV Source
Silver	0.02	Rungby and Danscher, 1984	0.2 (1)	Rungby and Danscher, 1984	5.44	Peterson and Jensen, 1975	54.4 (1)	Peterson and Jensen, 1975
Thallium	0.0074	Sample et al., 1996	0.074	Sample et al., 1996	n/a		n/a	
Zinc	160	Sample et al., 1996	320	Sample et al., 1996	14.5	Sample et al., 1996	131	Sample et al., 1996
Benzo(a) anthracene	0.17 (2)	PRC, 1996	1.7	PRC, 1996	2	Trust et al., 1993	20(1)	Trust et al., 1993
Benzo(a)pyrene	1.31	Sample et al., 1996	10	Sample et al., 1996	2	Trust et al., 1993	20(1)	Trust et al., 1993
Benzo(b) fluoranthene	4 (2)	PRC, 1996	40	PRC, 1996	2	Trust et al., 1993	20(1)	Trust et al., 1993
Benzo(g,h,i) perylene	7.2 (2)	PRC, 1996	72	PRC, 1996	2	Trust et al., 1993	20(1)	Trust et al., 1993
Benzo(k) fluoranthene	7.2 (2)	PRC, 1996	72	PRC, 1996	2	Trust et al., 1993	20(1)	Trust et al., 1993
Chrysene	0.17 (2)	PRC, 1996	1.7	PRC, 1996	2	Trust et al., 1993	20(1)	Trust et al., 1993
Dibenz(a,h) anthracene	1.33 (2)	PRC, 1996	13.3	PRC, 1996	2	Trust et al., 1993	20(1)	Trust et al., 1993
Fluoranthene	12.5	Sample et al., 1996	25	Sample et al., 1996	2	Trust et al., 1993	20(1)	Trust et al., 1993
Indeno(1,2,3-cd) pyrene	7.2 (2)	PRC, 1996	72	PRC, 1996	2	Trust et al., 1993	20(1)	Trust et al., 1993
Perylene	n/a		n/a		2	Trust et al., 1993	20(1)	Trust et al., 1993
Pyrene	7.5	Sample et al., 1996	12.5	Sample et al., 1996	2	Trust et al., 1993	20(1)	Trust et al., 1993
Acenaphthene	17.5	Sample et al., 1996	35	Sample et al., 1996	2	Trust et al., 1993	20(1)	Trust et al., 1993
Acenaphthylene	70 (2)	PRC, 1996	700	PRC, 1996	2	Trust et al., 1993	20(1)	Trust et al., 1993
Anthracene	100 (2)	IT Corp., 1997	1000	IT Corp., 1997	2	Trust et al., 1993	20(1)	Trust et al., 1993

Table B-1. Proposed TRVs for Use in Food Chain Modeling in the Quantico Post IRA Study

Analyte	Low Mammalian TRV (mg/kg·d)	Low Mammalian TRV Source	High Mammalian TRV (mg/kg·d)	High Mammalian TRV Source	Low Avian TRV (mg/kg·d)	Low Avian TRV Source	High Avian TRV (mg/kg·d)	High Avian TRV Source
Fluorene	125 [2]	PRC, 1996	1250	PRC, 1996	2	Trust et al., 1993	20[1]	Trust et al., 1993
Total PCBs	0.14 [3]	Sample, 1998	0.69 [3]	Sample, 1998	0.18 [2]	Sample, 1998	1.8	Sample, 1998
4,4-DDD	0.8	Navy, 1998	16	Navy, 1998	0.009	Navy, 1998	n/a	
4,4-DDE	0.8	Navy, 1998	16	Navy, 1998	0.009	Navy, 1998	0.6	Navy, 1998
4,4-DDT	0.8	Navy, 1998	16	Navy, 1998	0.009	Navy, 1998	1.5	Navy, 1998
Aldrin	0.2	Sample, 1998	1	Sample, 1998	n/a		n/a	
Alpha-chlordane	4.58	Sample et al., 1996	9.2	Sample et al., 1996	2.14	Sample et al., 1996	10.7	Sample et al., 1996
Dieldrin	0.02	Sample et al., 1996	0.2	Sample et al., 1996	0.077	Sample et al., 1996	0.77 [1]	Sample et al., 1996
Gamma-BHC (Lindane)	0.05	Navy 1998	3.75	Navy 1998	2 [2]	Sample et al., 1996	20	Sample et al., 1996
Gamma-chlordane	4.58	Sample et al., 1996	9.2	Sample et al., 1996	2.1	Sample et al., 1996	10.7	Sample et al., 1996

*n/a = no TRV available

[1] NOAEL was multiplied by 10 to estimate the LOAEL

[2] LOAEL was divided by 10 to estimate the NOAEL

[3] Multiple NOAELs were presented in Sample et al. The NOAEL of 0.14 was based on mink studies and was deemed most appropriate for Quantico Embayment receptors.

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IT Corporation. 1997 (Nov.). Predictive Ecological Risk Assessment Methodology. Environmental Restoration Program, Sandia National Laboratory, New Mexico. Sandia National Laboratory. Albuquerque, NM. Appendix A, Table A.1

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